

FULL REVIEW

Full Review: Thermodynamic Processes and PV Diagrams — Foundational

Review the essential ideas, relationships, and problem-solving tools for Thermodynamic Processes and PV Diagrams.

 TIME 45–60 minutes	 BEST FOR A complete topic review	 FINISH WITH A readiness check
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After this full review, you'll be able to...

recall the essential ideas, apply them to representative problems, and determine what to study next.

HOW TO USE THIS GUIDE

Work through the stages in order. Write directly in the spaces provided, check your work in the Solutions section, and finish by choosing the next resource that matches your confidence.

Choose how you want to review: work through this guide, follow the online review, or watch the video review.

[Start the Review Online →](#)

[Watch the Video Review →](#)

YOU WILL NEED

Pencil or pen • Calculator if needed • Approximately 45–60 minutes

FR-02 • COURSE ALIGNMENT

Course Alignment

This Physics Sensei Unit Review is an independent learning resource. Use it to reinforce key concepts, prepare for homework, or review before a quiz or exam.

RESOURCE: Physics Sensei Unit Review
UNIT ID: THM-U09
TOPIC: Thermodynamic Processes and PV Diagrams
COURSE LEVEL: Foundational

BEST USED

- ✓ After learning the unit
- ✓ Before starting homework
- ✓ Before a quiz or exam

FR-03 • YOUR REVIEW PLAN

Your Review Plan

Complete these six stages in order. Each stage builds on the previous one and prepares you for the final readiness check.

6 stages • Approximately 45–60 minutes

1 Warm-Up Check Activate prior knowledge.	2 Core Concepts Review the essential ideas.	3 Guided Practice Apply what you learned.
4 Confidence Check Confirm your understanding.	5 Summary Review the key ideas.	6 Next Step Continue your learning.

PRINTING TIP

For student copies, print double-sided and keep the Solutions section after the student activities so learners attempt each activity before checking their work.

FR-04 • STAGE 1 OF 6

Warm-Up Check

Before you begin, take a moment to see what you already remember. Do not worry about getting everything right. This is only a starting point.

ACTIVITY 1**Recall Activity 1**

Recall the defining condition for each common process.

State the defining constraint for isochoric, isobaric, isothermal, and adiabatic processes.

ACTIVITY 2**Recall Activity 2**

Read process direction directly from the axes.

On a P - V diagram, what do a rightward path, a leftward path, and a vertical path tell you about volume and work?

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

Use area to compare work.

Two gases expand through the same volume change. Path A stays at higher pressure than Path B. Which process does more work by the gas?

Ready to strengthen your understanding?

You've refreshed what you already know. Next, reinforce the essential concepts that will help you solve problems with confidence.

Continue to Core Concepts →

FR-05 • STAGE 2 OF 6

Core Concepts

Let's rebuild the key ideas one step at a time. Focus on understanding the relationships before worrying about solving problems.

KEY CONCEPT 1

Four common thermodynamic processes

A process describes how a system moves from one equilibrium state to another. Isochoric means volume is fixed, isobaric means pressure is fixed, isothermal means temperature is fixed, and adiabatic means no heat crosses the system boundary. The constraint is more important than the visual direction of the path.

$$\text{Isochoric: } \Delta V = 0 \cdot \text{Isobaric: } \Delta P = 0 \cdot \text{Isothermal: } \Delta T = 0 \cdot \text{Adiabatic: } Q = 0$$

EXAMPLE A vertical P–V path is isochoric even if pressure changes substantially.

SENSEI NOTE Isothermal and adiabatic are different ideas: one fixes temperature, the other fixes heat transfer.

KEY CONCEPT 2

P–V diagrams and work

A P–V diagram places pressure on the vertical axis and volume on the horizontal axis. Work by the gas is tied to the area under the process path. Expansion produces positive work; compression produces negative work under the sign convention used in this review.

$$W = \text{signed area under the P–V path; expansion: } W > 0 \cdot \text{compression: } W < 0$$

EXAMPLE A horizontal expansion at higher pressure has more area and therefore more positive work than the same expansion at lower pressure.

SENSEI NOTE A vertical path has zero work because volume does not change.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Paths and cycles carry energy information

Pressure and volume endpoints do not by themselves determine the work. Different paths between the same states can have different areas and therefore different work. In a closed cycle the system returns to its starting state, so its net change in internal energy is zero; the enclosed P–V area represents the net work.

For a complete cycle: $\Delta U = 0$ and net heat added = net work by the gas

EXAMPLE A clockwise loop has positive net work because expansion occurs at higher pressure than compression.

SENSEI NOTE Do not confuse a state change with a path quantity. Work and heat depend on the path taken.

Ready to apply these ideas?

You've reinforced the essential concepts. Now put them into practice by working through guided examples and building your problem-solving confidence.

[Continue to Guided Practice →](#)

FR-06 • STAGE 3 OF 6

Guided Practice

Now it's time to apply what you've reviewed. Work through each activity in order. The examples become gradually more challenging, and each prepares you for the final readiness check.

PRACTICE 1**Worked Example**

Classify each segment and interpret its work.

A gas goes upward at fixed volume, then right at fixed pressure, then down at fixed volume. Name the three segments and state the sign of work on each.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Compare work for two paths between the same volumes.

Path A expands entirely above Path B on the P - V diagram. Both begin and end at the same volumes. Which path has larger work by the gas, and why?

PRACTICE 3

Independent Problem

Interpret a complete cycle.

A rectangular cycle is traversed clockwise. During which part is positive work produced, during which part is negative work produced, and what does the enclosed area represent?

Ready to check your understanding?

You've practiced the essential skills with guidance. Now solve a few short problems on your own and confirm you're ready to move forward.

Continue to Confidence Check →

FR-07 • STAGE 4 OF 6

Confidence Check

You've rebuilt the key ideas and practiced them with guidance. Now try these short questions on your own to check your understanding before moving on.

QUICK CHECK 1**Vertical path check**

Use the P - V axes.

A process is vertical on a P - V diagram. What quantity is constant, and what is the boundary work?

QUICK CHECK 2**Adiabatic check**

Use the energy-transfer definition.

What defining statement makes a process adiabatic?

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Cycle check

Interpret the signed enclosed area.

What does a clockwise closed loop on a P - V diagram tell you about the net work by the gas?

HOW DID IT GO?

I answered ____ of 3 questions correctly.

Use the Solutions section to check your reasoning, then take one final look at the essential ideas.

You've checked your understanding.

Take one final look at the essential ideas before deciding what to do next.

Continue to Summary →

FR-08 • STAGE 5 OF 6

Summary

Before moving on, take one final look at the most important ideas from this review.

KEY TAKEAWAY 1**Process names encode constraints**

Isochoric, isobaric, isothermal, and adiabatic processes are identified by what is fixed or by the absence of heat transfer.

KEY TAKEAWAY 2**P–V area is work**

The signed area under a path gives work by the gas; vertical constant-volume paths do zero work.

KEY TAKEAWAY 3**Cycles reveal net energy transfer**

A closed cycle returns to the initial state, so $\Delta U = 0$. The signed enclosed P–V area is the net work by the gas.

MY ONE-SENTENCE SUMMARY

In my own words, the most important idea is:

Ready for your next step?

You've reviewed the essential ideas one last time. Now choose the resource that best matches how confident you feel.

Continue to Next Step →

ANSWER KEY • CHECK AFTER ATTEMPTING

Solutions and Explanations

Use these solutions to check your reasoning—not only your final answer. Focus on the essential explanation behind each result.

WARM-UP • ACTIVITY 1**Recall Activity 1**

Isochoric: volume constant. Isobaric: pressure constant. Isothermal: temperature constant. Adiabatic: no heat transfer.

WHY IT WORKS These constraints are the fastest way to classify a thermodynamic path.

WARM-UP • ACTIVITY 2**Recall Activity 2**

Rightward: expansion and positive work. Leftward: compression and negative work. Vertical: constant volume and zero work.

WHY IT WORKS The horizontal coordinate is volume; P – V work depends on displacement in volume.

WARM-UP • ACTIVITY 3**Recall Activity 3**

Path A.

WHY IT WORKS The area under Path A is larger over the same volume interval.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1**Worked Example**

Isochoric, isobaric expansion, isochoric. The work signs are zero, positive, zero.

WHY IT WORKS Only the horizontal expansion changes volume.

PRACTICE 2**Guided Problem**

Path A has larger positive work because it has the larger area under the curve.

WHY IT WORKS Work is path-dependent and is represented by signed P - V area.

PRACTICE 3**Independent Problem**

Rightward expansion gives positive work; leftward compression gives negative work; the enclosed area is the positive net work by the gas.

WHY IT WORKS The higher-pressure expansion area exceeds the lower-pressure compression area.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Vertical path check

Volume is constant, and the boundary work is zero.

WHY IT WORKS There is no change in volume.

QUICK CHECK 2

Adiabatic check

No heat is transferred across the system boundary, so $Q = 0$.

WHY IT WORKS Adiabatic is defined by heat transfer, not by constant temperature.

QUICK CHECK 3

Cycle check

The net work by the gas is positive and equals the enclosed area.

WHY IT WORKS Expansion occurs at higher pressure than compression for a clockwise loop.

READINESS GUIDE

3 correct: You're ready to continue. • 2 correct: Review the missed idea, then continue. • 0–1 correct: Revisit Core Concepts or choose more practice.

FR-09 • STAGE 6 OF 6

Next Step: Continue Learning

Great work! You've completed this review. Choose the next resource that best matches how confident you feel.

 I'm Still Unsure Review the key ideas and examples again. Review Again →	 I Need More Practice Continue with additional practice for this topic. Go to Practice →	 I'm Ready Continue to the next recommended resource. Continue →
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RECOMMENDED LINKS

[Review this topic again →](#)[Find additional practice →](#)[Choose another type of physics help →](#)

Continue reviewing with these companion resources.

[Start the Review Online →](#)[Watch the Video Review →](#)

PHYSICS HELP THAT MAKES SENSE

A Physics Sensei review never ends at the last question. It always guides you toward the next useful step.

PhysicsSensei.com